

REMARKS/ARGUMENTS

Reconsideration and withdrawal of the rejections of the application and consideration and entry of this paper are respectfully requested in view of the herein remarks, which place the application in condition for allowance.

I. STATUS OF THE CLAIMS AND FORMAL MATTERS

Claims 1-12 are pending in this application and are rejected in the Office Action mailed on July 25, 2008. By this paper, claims 1, 2, 6, and 7 are hereby amended. No new matter has been introduced. Support for this amendment is provided throughout the Specification as originally filed, for example, paragraphs [0015] and [0018] (corresponding to paragraphs [0028] and [0031] of the application published as US 2007/0020125 (the “as published” application)).

Additionally, a typographical error was found throughout the Specification and Abstract as originally filed. Specifically, the word “lace” was incorrectly used for “race” at each occurrence. A Substitute Specification, including a Substitute Abstract, has been provided, in a marked-up version with the corrections noted (with document number 595732 in the footer), and a clean version (document number 595743 in the footer), incorporating the corrections of the obvious error.

The same typographical error was found in claims 2 and 7 of the pending claims. As indicated above in the listing of claims, claims 2 and 7 have been amended to correct the obvious error.

Changes to the claims are not made for the purpose of patentability within the meaning of 35 U.S.C. §101, §102, §103, or §112. Rather, these changes are made simply for clarification and to round out the scope of protection to which Applicants are entitled.

II. REJECTIONS UNDER 35 U.S.C. §103

On page 2 of the Office Action, claims 1-12 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over U.S. Patent Application Publication No. 2002/0090306 to Alaze et al. ("Alaze") in view of U.S. Patent No. 1,162,512 to Prinz ("Prinz"). The rejections are traversed for at least the following reasons.

As currently understood by Applicants' attorneys, Alaze is directed to a pump assembly having an electric motor and a piston pump. *Alaze*, Abstract. In numbered paragraph 3 of the Office Action, the Examiner asserts Alaze teaches a motor having an eccentric portion identified as element 32. However, Alaze teaches that element 32 is an "eccentric chamber in the pump housing" in at least paragraphs [0016] and [0018]. Accordingly, the element identified in Alaze to correspond to the eccentric portion of the instantly claimed motor is actually a chamber in the pump. Consequently, a chamber in a pump cannot be an eccentric portion in a motor.

Further, instantly amended independent claims 1 and 6 recite, inter alia:

A motor having...an armature and a commutator...the armature...formed such that a center portion thereof is recessed and the ball bearing and the commutator are arranged such that at least part of the ball bearing and part of the commutator are inserted into the recessed part. (Emphasis added.)

Accordingly, the instantly claimed motor has ball bearings and a commutator that are at least partially placed within a portion of the armature. Alaze fails to teach such an arrangement.

In paragraph 4, the examiner concedes that Alaze does not teach the use of an eccentric ball bearing and relies upon Prinz to allegedly teach an eccentric ball bearing. However, contrary to the Examiner's assertion, Prinz does not teach an eccentric ball bearing. As recited on lines 73-79 in Prinz, element 13 is a split eccentric which is placed around a drive shaft. Sleeve 15 is placed around the outside surface of the split eccentric. The exterior of the sleeve is

tapered to engage the interior of a race ring 9 for balls 11. The eccentric and the ball bearing are, therefore, not the same element.

As can be seen in fig. 2 of Prinz, cited by the Examiner, the race ring 9 has a tapered inner surface to engage the tapered sleeve. A tapered surface is not eccentric and the race ring is not taught to be eccentric in its design. The effect of mounting the race ring on the split eccentric is a race ring having a center spaced a distance from the axis of the drive shaft, therefore eccentric to the drive shaft. However, this is not the same as an eccentric ball bearing as instantly claimed. Accordingly, there is no teaching for an eccentric ball bearing in Prinz.

For at least the foregoing reasons, it is believed that revised independent claim 1 patentably distinguishes over the relied upon portions of Alaze and Prinz, either alone or in combination, and is therefore allowable. Independent claim 6 is similar, or somewhat similar, in scope to claim 1, and is therefore allowable for similar, or somewhat similar, reasons. Further, claims 2-5 and 10-12, which depend from claim 1, and claims 7-9, which depend from claim 6, are allowable as well.

Statements appearing above with respect to the disclosures in the cited references represent the present opinions of the Applicants' undersigned attorney and, in the event that the Examiner disagrees with any such opinions, it is respectfully requested that the Examiner specifically indicate those portions of the respective reference providing the basis for a contrary view.


CONCLUSION

In view of the foregoing, Applicants' attorney believes that all of the claims in this application are patentable over the prior art, and an early and favorable consideration thereof is solicited.

The Commissioner is authorized to charge any additional fees that may be required to Deposit Account No. 50-0320.

Respectfully submitted,
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DESCRIPTION

MOTOR WITH ECCENTRIC PART AND PUMP DEVICE USING THE SAME

Technical Field

[0001]

The present invention relates to a motor having an eccentric portion which includes a rotational shaft which has an axis and supports an armature and a commutator thereon, and an eccentric portion which is eccentrically configured with respect to the axis on the rotational shaft, wherein the eccentric portion constitutes an output portion for driving an external equipment such as a pump in a hydraulic brake system of an automobile, for example. Further, the present invention also relates to a pump device which uses such a motor.

Background Art

[0002]

Since this type of motor or pump device is mounted on the automobile, it is desirable that the motor or the pump is miniaturized and vibrations and operation sounds thereof are reduced.

[0003]

To focus on the eccentric portion of the motor, conventionally, a rotational shaft is machined so as to form an eccentric shaft portion on a portion thereof, and a needle bearing or a ball bearing is joined to an outer periphery of the eccentric shaft portion. The needle bearing withstands a high load compared to the ball bearing. However, the ball bearing is disadvantageous in the miniaturization and the reduction of weight of the motor or the reduction of the vibrations and operation sounds of the motor. For example, patent literature 1 discloses a motor which uses the needle bearing and patent literature 2 discloses a motor which uses a ball bearing.

[Patent Literature 1] JP-A-11-252854

[Patent Literature 2] JP-A-2000-278904

Disclosure of the Invention

Task to be solved by the Invention

[0004]

According to the present invention, while focusing their attentions to a current situation in which a diameter of a pump or the like which is driven by way of an eccentric portion is made small and a weight of the pump is reduced, inventors have extensively studied an effective use of a ball bearing which is relatively suitable for a low load.

[0005]

As a result, the inventors have found that, conventionally, there has been mainly adopted a design concept that, to obtain the eccentric portion, a portion of the rotational shaft is eliminated by applying cutting to a portion of the rotational shaft thus forming an eccentric shaft portion in the eliminated portion. It is inevitable that such shaft cutting pushes up a cost. Accordingly, the inventors have challenged a unique idea that instead of forming the rotational shaft per se in an eccentric manner, the eccentric structure is provided to the whole structure including the ball bearing.

Means for solving the problem

[0006]

According to the present invention, an eccentric portion formed on a rotational shaft is constituted as follows. That is, in place of cutting a side of a rotational shaft, an eccentric ball bearing is directly joined to a shaft portion which is constituted of a portion of the straight rotational shaft so as to obtain an eccentric portion. In other words, the eccentric portion is constituted of a shaft portion (portion of the rotational shaft) having an axis equal to an axis of the rotational shaft and the eccentric ball bearing which is joined to the shaft portion. It is most preferable that an inner side of the eccentric

ball bearing having a smaller diameter is formed in an eccentric configuration. This is because that compared to a case in which an outer side of the eccentric ball bearing is formed in an eccentric configuration, the above-mentioned provision is advantageous in view of the machining of parts as well as a strength of the eccentric ball bearing. The eccentric ball bearing is constituted of an inner ~~lae~~erace which is arranged eccentric with respect to the axis of the rotational shaft, an outer ~~lae~~erace which is positioned outside the inner ~~lae~~erace and has an axis equal to the above-mentioned axis, and balls which are supported between the outer ~~lae~~erace and the inner ~~lae~~erace.

[0007]

On the rotational shaft having such an eccentric portion, an armature including a coil winding portion, a commutator for supplying electricity to the armature, and the eccentric portion which constitutes an output portion are arranged in this order. The eccentric portion is served for driving a pump for a hydraulic brake system of an automobile (an automatic brake served not only for a usual anti-skid control but also for a traction control and, further, for the safe traveling, the collision prevention and the like). Accordingly, in a usual case, the armature and the commutator are housed in a motor housing and the motor housing is mounted on one side of a control unit of the hydraulic brake

system.

[0008]

The ball bearing has the simple constitution compared to a needle bearing (for example, while a stop bushing which supports a side is necessary in the needle bearing, the stop bushing is unnecessary in the ball bearing) and hence, frictions are small whereby a motor current is low. Further, structurally, a length of the ball bearing in the rotational axis direction is short and, at the same time, the ball-bearing becomes light-weighted (particularly, a mass of the eccentric portion becomes light-weighted) and hence, the vibrations and noises can be suppressed.

[0009]

When the eccentric ball bearing is joined to the shaft portion which constitutes a portion of the straight rotational shaft as in the case of this embodiment, to take the effectiveness of the product into consideration from a viewpoint of durability and the like, it is necessary to reduce an output of the motor. According to an experiment, it is preferable to restrict the output of the motor to 150W or below, or it is preferable to apply the present invention to such an output. In this respect, as an external equipment such as a pump which is driven by way of the eccentric portion, it is necessary to select a low-load equipment

such as a small-diameter pump or to miniaturize a motor per se.

[0010]

Further, when the present invention is grasped in a form of a pump device, the pump device is configured such that the above-mentioned particular motor is used as a drive source and a plunger is brought into contact with an outer periphery of the eccentric ball bearing (that is, an outer ~~face~~race of the eccentric ball bearing). The pump device, along with a linear reciprocal motion of the plunger, repeats sucking and discharging of a working liquid. The plungers are usually provided in a pair and are arranged at positions which are spaced apart from each other by 180° in the circumferential direction of the eccentric ball bearing.

Brief Explanation of the Drawing

[0011]

Fig. 1 is a front view of a profile of an embodiment of a motor according to the present invention.

Fig. 2 is a cross-sectional structural view of the motor shown in Fig. 1.

Fig. 3 is a side view showing one example of an eccentric ball bearing.

Fig. 4 is a cross-sectional view taken along a line 4-4 of

Fig. 3.

Explanation of symbols

[0012]

10: motor
12: motor housing
30: rotational shaft
50: eccentric ball bearing
52: inner ~~lae~~erace
54: outer ~~lae~~erace
55: ball
70: armature
80: commutator
100: plunger pump

Best Mode for Carrying out the Invention

[0013]

Although the present invention is basically directed to a motor which has a specific eccentric portion, those who are skilled in the art will understand that the invention is applicable to a pump device which uses the motor as a drive source.

To explain the present invention in conjunction with Fig. 1 and Fig. 2, the DC motor 10 includes a motor housing 12 which

defines a columnar inner space therein. A height of the motor housing 12 is approximately half of a diameter of the motor housing 12. The motor housing 12 is constituted of a housing body 121 having a U-shape cross section and an end plate 122 which closes one end of the housing body 121. A flange portion 122f which is flared outwardly is formed on a center portion of the end plate 122. Further, a receiving portion 121r is formed on a center portion of the housing body 121 by press forming. To miniaturize the motor 10, the receiving portion 121r has a height equal to heights of other portions of the housing body 121 (that is, coplanar). The inside of the receiving portion 121r and the inside of the flange portion 122f form portions which support first and second bearings 21, 22. These two bearings 21, 22 are integrally formed with the motor housing 12 and such a constitution rotatably supports a rotational shaft 30 of the motor 10. The rotational shaft 30 is positioned at a center portion of the motor housing 12, wherein one end of the rotational shaft 30 is supported on the first bearing 21 arranged inside the receiving portion 121r of the housing body 121, an opposite side of the rotational shaft 30 has a midst portion thereof supported on the second bearing 22, and a portion of the rotational shaft 30 projecting from the second bearing 22 penetrates the end plate 122 and projects to the outside of the motor housing 12.

[0014]

Here, the rotational shaft 30 is formed of a straight so-called round bar which extends from a first end portion 31 on a side supported by the first bearing 21 to a second end portion 32 on a side projected to the outside. That is, the rotational shaft 30 has an equal axis over a total length thereof from the first end portion 31 to the second end portion 32. According to the present invention, on the rotational shaft 30 which is straight over the whole length, an eccentric ball bearing 50 is joined to and supported on a shaft portion which is positioned at an outside portion of the motor housing 12.

[0015]

Fig. 3 and Fig. 4 clearly show the eccentric ball bearing 50. The eccentric ball bearing 50 is constituted of an eccentric inner ~~race~~race 52, an outer ~~race~~race 54 which surrounds an outside of the inner ~~race~~race 52, and a plurality of balls 55 which are positioned between the inner ~~race~~race 52 and the outer ~~race~~race 54. The respective balls 55 are arranged in the circumferential direction between the inner ~~race~~race 52 and the outer ~~race~~race 54 and retainers 56 at both sides retain the balls 55. Accordingly, the basic constitutional elements per se of the eccentric ball bearing 50 are substantially equal to the basic constitutional elements of a usual ball bearing. However, while the center of

an inner-peripheral-side circle 54i and the center of an outer-peripheral-side circle 54o are equal with respect to the outer ~~lae~~face 54, the center of an inner-peripheral-side circle 52i and the center of an outer-peripheral-side circle 52o are eccentric from each other by a distance d with respect to the inner ~~lae~~face 52. The eccentric distance (that is, eccentricity) is, for example, slightly less than 1mm. Accordingly, when the eccentric ball bearing 50 including the inner ~~lae~~face 52 is joined to the shaft portion of the rotational shaft 30 in a close fit state, along with the rotation of the rotational shaft 30, the eccentric portion including the eccentric ball bearing 50 performs a reciprocal linear motion with a stroke of a size of $2d$ in the direction perpendicular to the axis of the rotational shaft 30. Due to such a motion, it is possible to drive a plunger pump 100. With respect to the plunger pump 100 per se, as described in JP-A-7-224755, for example, a plunger is brought into contact with an outer periphery of the eccentric ball bearing 50 and, in response to the reciprocal linear motion of the eccentric ball bearing 50, the plunger per se also performs the similar reciprocal linear motion thus generating a pumping action.

[0016]

Here, to focus on the inside of the motor housing 12 (see Fig. 2), first of all, a plurality of magnets 60 is mounted on

an inner peripheral wall surface of the housing body 121 having a U-shaped cross section. The respective magnets 60 generate a magnetic field together with the housing body 121 which functions as a yoke. Further, an armature 70 is arranged in an inner space surrounded by the magnets 60. The armature 70 includes a stacked core and a coil winding portion which is wound around the laminated core. The armature 70 per se is integrally supported on the rotational shaft 30 and is rotated together with the rotational shaft 30. Due to a cooperative action of an electric current which flows the coil winding portion of the armature 70 and the magnetic field which is generated by the magnet 60, a given force acts on the armature 70 and the force generates a rotating force of the motor 10.

[0017]

Since the electricity is supplied to the rotating armature 70 from the outside, a commutator 80 is arranged at a portion adjacent to the armature 70. The commutator 80 is integrally supported on the rotational shaft 30 between the armature 70 and a second bearing 22. The commutator 80 includes a cylindrical insulation ring 82 which is formed of a resin molded product and a plurality of commutator members 84 which are assembled to an outer periphery of the insulation ring 82. The insulation ring 82 is made of an electrically insulating resin material, while

a plurality of commutator members 84 are made of a conductive metallic material such as copper. A riser 84r which is formed by folding one end of the commutator members 84 is a portion which catches respective commutator members 84 and end portions of coils of the respective coil winding portions of the armature 70. The commutator 80 is connected with an external circuit along with a brush for supplying electricity. A cable 90 which is extended from a lower portion of the motor housing 12 is provided for connecting the brush and the external circuit for supplying electricity.

[0018]

In this motor 10 which uses the eccentric ball bearing 50, to realize the miniaturization of the motor 10, particularly, to realize the reduction of a length of motor 10 in the direction of the rotational shaft 30, the armature 70 is formed in a state that a center portion thereof is recessed and respective parts of the first bearing 21 and the commutator 80 which are arranged close to the recessed portion are inserted into the recessed portions.

ABSTRACT

In the present invention, without forming a rotational shaft (30) per se in an eccentric manner, the eccentric structure is provided to the whole structure including a ball bearing (50). Accordingly, in place of cutting a side of the rotational shaft (30), the eccentric ball bearing (50) is joined to a shaft portion of the straight rotational shaft (30) so as to obtain an eccentric portion. That is, the eccentric portion is constituted of the shaft portion which has an axis aligned with an axis of the rotational shaft (30) and the eccentric ball bearing (50) which is joined to the shaft portion. As the eccentric ball bearing, it is optimum to adopt a mode in which an inner side thereof having a smaller diameter is formed in an eccentric manner. The eccentric ball bearing (50) is constituted of an inner ~~layer~~race (52) which is arranged eccentric with respect to the axis of the rotational shaft (30), an outer ~~layer~~race (54) which surrounds an outside of the inner ~~layer~~race (52) and balls (55) which are supported between the outer ~~layer~~race (54) and the inner ~~layer~~race (52).